

http://doi.org/10.11646/zootaxa.4137.4.8
http://zoobank.org/urn:lsid:zoobank.org:pub:9935AF06-E546-4E3A-829D-DCC930B3EC2F

The European species of *Foersterella* Dalla Torre (Hymenoptera: Tetracampidae), including the description of two new species

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Abstract

The European species of *Foersterella* Dalla Torre 1897 (Hymenoptera: Tetracampidae) are treated, including two previously described species, *F. erdoesi* Bouček and *F. reptans* (Nees), and two new species, *F. angusticornis* sp. nov. and *F. fuscicornis* sp. nov. Morphological concepts of the species are based mainly on characters in the male antenna, which females lack, and with the exception of *F. erdoesi* females are currently not possible to identify to species. A key for the identification of species is included, as well as illustrations to facilitate the identification.

Key words: *angusticornis*, *erdoesi*, *fuscicornis*, *reptans*, identification key

Introduction

The Tetracampidae is one of the smallest families of the Chalcidoidea (Hymenoptera), with 59 species in 15 genera (Noyes 2016). These numbers include three genera and nine species in the subfamily Mongolocampinae, which possibly belongs in the family Aphelinidae (Bouček 1988; LaSalle *et al.* 1997). Tetracampidae has an almost worldwide distribution, but has this far not been recorded from South America. *Epiclerus* Haliday 1844, is the largest genus of the family, including 20 species, which is twice the number of the second largest, *Foersterella* Dalla Torre 1897, the focus group of this paper.

Eight species currently comprise *Foersterella*, three from Asia (India and Turkey), two from Australasia (Australia and Papua New Guinea), two from Europe (Noyes 2016), and one from Africa (Gumovsky 2016). With the addition of the two species described here there are ten species, four of which occur in Europe. Labeyrie (1961) investigated the biology of *F. reptans* (Nees), one of the European species, which develops as solitary endoparasitoids in eggs of the tortoise beetle *Cassida deflorata* Suffrian (Coleoptera: Chrysomelidae). The other previously known European species, *F. erdoesi* Bouček, is also recorded from *Cassida* eggs (*C. viridis* L.). *Foersterella australis* Burwell, from Australia, has the same biology as the European species but targets a different *Cassida* species, *C. compuncta* (Boheman). Due to the difficulties with identifying females and the erroneous association of the sexes in *F. erdoesi*, as demonstrated below, published records of host and distribution must be treated with caution.

Methods

The images were made using Canon camera equipment including an EOS 70D body, MP E-65 macrolens, and macro twin lite MT-24 EX. The camera was attached to a Cognisys stackshot macrorail system. The picture stacking was done with Helicon Focus version 6 software. Museum acronyms used are BMNH = the Natural History Museum, London, United Kingdom; MZLU = Biological Museum (Entomology), Lund University, Sweden. Abbreviations used for antennal structures are F1, F2 etc. = flagellomere 1, 2 etc.; C1, C2, C3 = clavomere 1, 2, 3. The face is defined as the frontal surface of the head between the mouth opening and the level of the toruli.

***Foersterella* Dalla Torre**

Hyperbius Förster, 1878: 58. Type species: *Tetracampe flavipes* Förster (1841), by original designation and monotypy. Name preoccupied by *Hyperbius* Stål (1867).

Foersterella Dalla Torre, 1897: 86. Replacement name.

Species identification. Species of *Foersterella* are characterized by a short petiole that is wider than long, a very long antennal pedicel that is 2.3–2.5× as long as wide and at least twice as long as the first flagellomere, an antennal clava that usually is distinctly wider than the first flagellomere, and by an enlarged male scape that is about twice as long as wide and pale yellow. They are morphologically very similar to one another, displaying differentiating characters mainly in the male antenna and to some extent in the female gaster. Thus, without additional information, such as host or molecular data, it is difficult to associate females and males of the same species in this genus. When *F. erdoesi* was described by Bouček (1958) he unknowingly associated female and male incorrectly. The female and male included in the description belong to two different species, which became clear when I was able to examine a small series (2♀, 3♂ in BMNH) of reared specimens from *Cassida viridis* from Romania. Females of this series agree well with the original description of *F. erdoesi* whereas the males are different from the male described as *F. erdoesi*. Bouček did not have access to reared material so his mistake is understandable. The holotype of *F. erdoesi* is a female so this is the name-bearing sex. The antennal flagellum of the male described as *F. erdoesi* is different from that of the true *F. erdoesi* male in that it is completely dark (Figs 4, 10), whereas it is bicoloured in *F. erdoesi* (Figs 2, 7) and *F. reptans* (Figs 3, 8), the other European species. The male of *F. erdoesi sensu* Bouček is here described as a new species.

Females identified as *F. erdoesi* differ from other females examined here as indicated in the key below. The other females (101 females examined from Austria (2), Czech Republic (7), England (20), France (7), Hungary (1), Slovakia (1), Spain (2), and Sweden (61), in BMNH and MZLU), do not show any noticeable morphological differences. In view of that there are three additional species apart from *F. erdoesi*, it is difficult to assign a species identity to these females. The females of these three species therefore have to remain unassociated until biological and/or molecular information facilitates their species association to males.

Key to European species of *Foersterella*

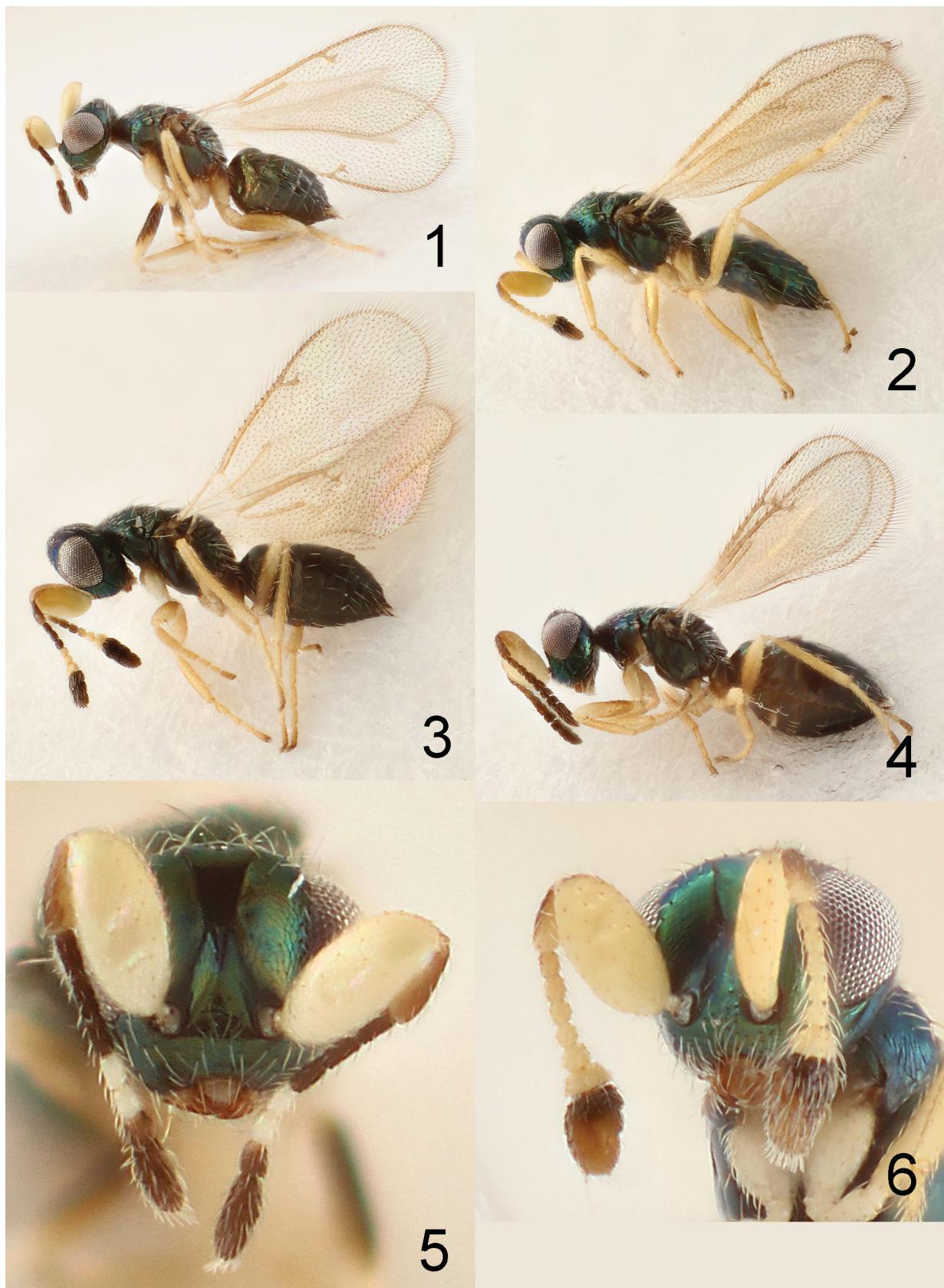
1	Scape strongly enlarged, 2.0× as long as wide and pale (Figs 7–10) (males)	2
-	Scape narrow, about 3.5× as long as wide and dark (Figs 11, 14) (females)	5
2	Antennal flagellum completely dark (Figs 4, 10)	<i>F. fuscicornis</i> sp. nov.
-	Antennal flagellum with at least two flagellomeres pale (Figs 7–9)	3
3	F1–F6 pale and clava with C2–3 pale brown (Figs 2, 7)	<i>F. erdoesi</i> Bouček
-	F1–F3 and clava completely dark (Figs 1, 3, 8, 9)	4
4	F6 pale and 0.7× as long as wide (Fig. 8); F1–F3 shorter (Fig. 8), F1+2+3 = 3.7× as long as wide; fore femur pale (Fig. 3)	<i>F. reptans</i> (Nees)
-	F6 dark and 1.4× as long as wide (Fig. 9); F1–F3 longer (Fig. 9), F1+2+3 = 5.8× as long as wide; fore femur predominantly dark (Fig. 1)	<i>F. angusticornis</i> sp. nov.
5	Gaster long with apex pointed (Fig. 13), 2.0–2.4× (mean 2.18, n = 7) as long as wide	<i>F. erdoesi</i> Bouček
-	Gaster shorter and with apex less pointed (Fig. 12), 1.2–1.7× (mean 1.47, n = 10) as long as wide	<i>Foersterella</i> spp. (not possible to identify to species)

***Foersterella angusticornis* sp. nov.**

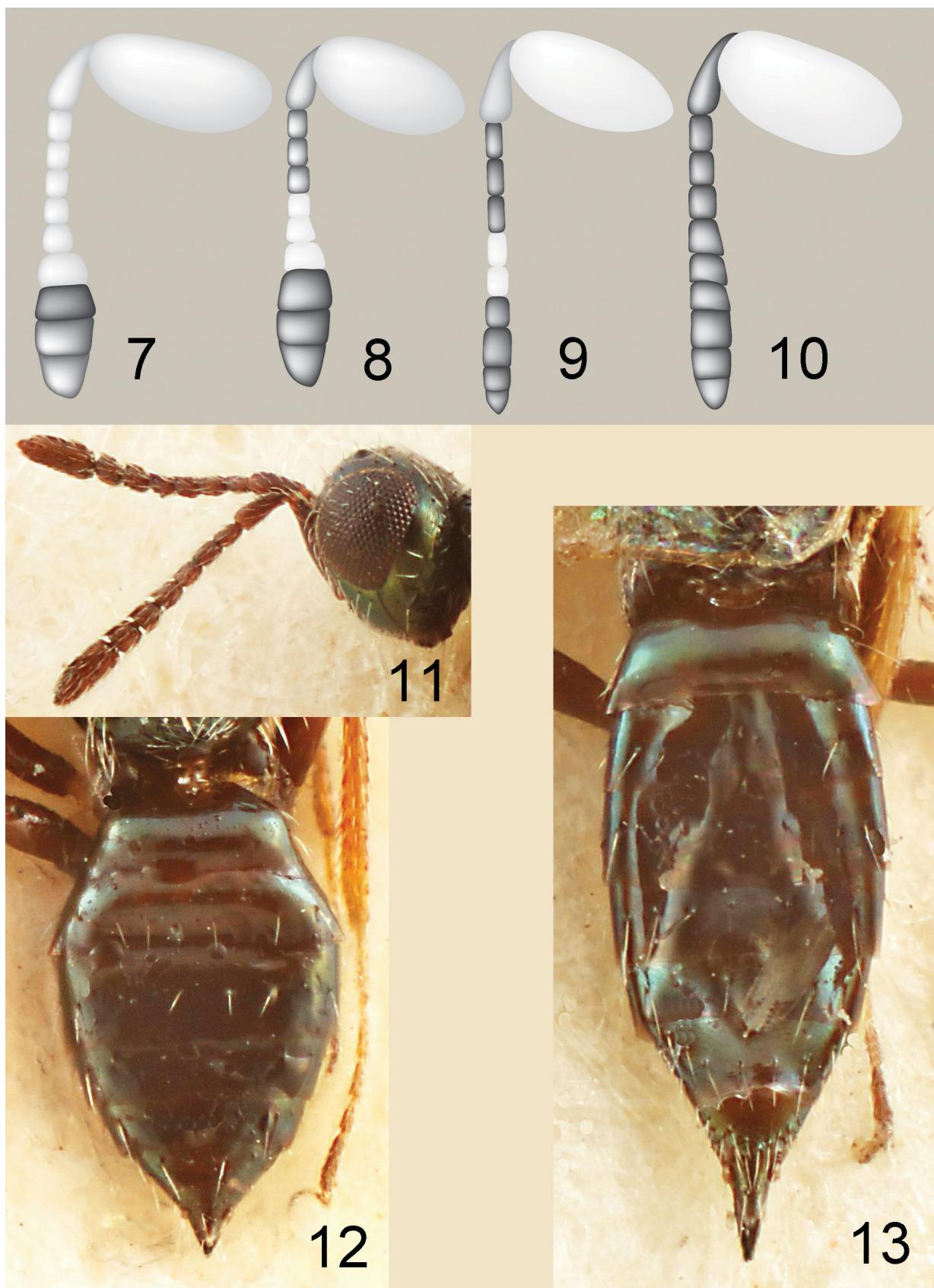
Figs 1, 5, 9

Material. Holotype male labeled “SWEDEN: Skåne, Kranke, Ekskogen, 55°41'10.3N 13°27'40.2E, 11.vii.2014, C. Hansson”, in MZLU. Paratypes (7♂): 6♂ collected in Sweden: Närke, Örebro, Adolfsberg, by Anton Jansson, with collecting dates: 23.viii.1956 (MZLU), 16.ix.1956 (MZLU), 22.vii.1957 (MZLU), 4.viii.1957 (BMNH), 16.viii.1957 (MZLU), 29.viii.1957 (MZLU); 1♂ “Sweden: Närke, Örebro, 19.viii.1955, A. Jansson” (BMNH).

Diagnosis. *Male.* Antenna (Figs 1, 9): antennal flagellum slender, e.g. F1–3 each 2.2× as long as wide, and F6 1.3× as long as wide; antennal clava (in widest part) 0.9× as wide as greatest width of pedicel; F1–3, F6, and clava dark brown, F4 and F5 white; face with rather thin setation (Fig. 5); fore femur predominantly dark brown (Fig. 1).



FIGURES 1–6. 1–4, *Foersterella* spp., habitus in lateral view: 1, *F. angusticornis* sp. nov., male holotype, specimen length 1.1 mm; 2, *F. erdoesi* Bouček, male non-type from Sweden (Skåne), specimen length 1.3 mm; 3, *F. reptans* (Nees), male non-type from Sweden (Skåne), specimen length 1.1 mm; 4, *F. fuscicornis* sp. nov., male holotype, specimen length 1.2 mm. 5 & 6. Head, frontal view, males: 5, *F. angusticornis*, holotype; 6, *F. erdoesi*, non-type from Sweden (Skåne).



FIGURES 7–13. *Foersterella* spp. 7–10, antenna, lateral view, male: 7, *F. erdoesi* Bouček; 8, *F. reptans* (Nees); 9, *F. angusticornis* sp. nov.; 10, *F. fuscicornis* sp. nov. 11, *Foersterella* sp., female, head and antennae, lateral view. 12 & 13, gaster, dorsal view, female: 12, *Foersterella* sp.; 13, *F. erdoesi*.

Description (male holotype, a non-shrivelled specimen). Length: 1.1 mm.

Colour. Scape yellowish-white, pedicel pale brown with dorsal part darkened, F1–3, F6, and clava dark brown, F4 and F5 white. Head, mesosoma and gaster golden-green. Fore coxa yellowish-white with base infuscate, mid coxa yellowish-brown with base infuscate, hind coxa with basal $\frac{1}{3}$ dark brown with golden-green tinges and apical $\frac{2}{3}$ yellowish-brown; fore tibia dark brown with apical $\frac{1}{4}$ yellowish-brown, mid and hind femora yellowish-brown; tibiae yellowish-brown; tarsi with tarsomeres 1–3 yellowish-brown and tarsomere 4 pale brown. Wings hyaline.

Head. Scape 2.0× as long as wide; ratios length/width of flagellomeres I/II/III/IV/V/VI: 2.2/2.2/2.2/1.8/1.4/1.3. Frons and vertex with very weak and superficial reticulation; occipital margin rounded without carina. Ratios width/height/length of head 1.9/1.4/1.0; height of eye/malar space/mouth opening 2.0/1.0/1.4; distances between posterior ocelli (POL)/between ocelli and eyes (OOL) 1.7/1.0.

Mesosoma. Mesosoma 1.5× as long as wide. Pronotum medially 1.6× as long as midlobe of mesoscutum. Mesoscutum 0.7× as long as scutellum, with very weak and fine reticulation and short setae scattered over surface; midlobe with two long setae close to posterior margin; notauli complete and deep. Scutellum 1.1× as long as wide, with very weak and fine reticulation and two pair of setae attached close to lateral margin, the anterior pair about in middle and posterior pair $\frac{2}{3}$ from anterior margin of scutellum. Fore wing 2.6× as long as wide; submarginal vein with four setae on dorsal surface; speculum small and closed below; basal cell covered with setae; costal cell narrow, 13× as long as wide, with a complete row of 11 setae on ventral surface; ratios of length of marginal/postmarginal/stigmal veins 7.5/4.4/1.0. Propodeum steeply sloping; median part with 10+10 setae on either side of an imaginary median line and setae pointing towards the imaginary median line; propodeal callus with 14 setae.

Metasoma. Petiole very short and inconspicuous. Gaster ovate, 1.3× as long as wide. Ratio length of mesosoma/length of gaster 1.0.

Variation. Minimal in the paratype material, the length varies from 0.9–1.1 mm, and in one specimen the fore coxa is yellowish-brown.

Female. Unknown.

Host. Unknown, but based on records for other species in *Foersterella* it probably is an egg parasitoid of some species of *Cassida* (Coleoptera: Chrysomelidae).

Distribution. Sweden.

Etymology. Named after the comparatively slender antennal flagellum in the male.

***Foersterella erdoesi* Bouček**

Figs 2, 6, 7, 13

Foersterella erdoesi Bouček, 1958: 69. Holotype female in HNHM, not examined.

Material. Type material: 2♀ paratypes of *F. erdoesi* (BMNH). Additional material (6♀, 21♂): England (1♂ BMNH); Romania (2♀, 3♂ BMNH); Sweden (4♀, 17♂ BMNH, MZLU).

Diagnosis. *Male.* Antenna (Figs 2, 6, 7): F1–3 each 1.2×, and F6 0.7× as long as wide; antennal clava (in widest part) 2.0× as wide as greatest width of pedicel; F1–6 yellowish-brown, C1 dark brown, C2 and C3 pale brown (pale part more distinct on ventral side of clava); face with rather dense setation (Fig. 6). *Female.* Gaster elongate, 2.0–2.4× (mean 2.18, n = 7) as long as wide, with apex pointed (Fig. 13).

Host. Endoparasitoid in eggs of *Cassida viridis* L. (Coleoptera: Chrysomelidae) (record checked).

Distribution. Hungary (Bouček 1958), Romania, Sweden, United Kingdom (all records checked).

***Foersterella fuscicornis* sp. nov.**

Figs 4, 10

Material. Holotype male labeled “SWEDEN: Öland, Bostorpsvägen, 56°38'56.8N 16°35'25.5E, 25.vi.2014, C. Hansson”, in MZLU. Paratypes (6♂): 1♂ “SWEDEN: Öland, Bärby Borg, 56°30'09.0N 16°25'33.1E, 1.vii.2014, C. Hansson” (MZLU); 2♂ “SWEDEN: Öland, Karums Alvar, 56°46'28.1N 16°37'30.6E, 4.vii.2014” (BMNH, MZLU); 1♂ “FRANCE: B du Rhône, Fonscolombe (3), 18.vii.1979, M.W.R. de V. Graham” (BMNH); 1♂ from

same locality as previous but collected 25.vii.1979 (BMNH); 1♂ “FRANCE: (Ht Rhin), Wintzenheim, on *Tanacetum vulgare*, 27.vii.1974, Remaudiere” (BMNH).

Diagnosis. *Male.* Antenna (Figs 4, 10): flagellum completely dark; F1 1.5×, F2 1.3×, F3 1.2×, and F6 0.7× as long as wide; antennal clava (in widest part) 1.3× as wide as greatest width of pedicel; face with rather thin setation, as in *F. angusticornis* (Fig. 5).

Description (male holotype, a non-shrivelled specimen). Length: 1.2 mm.

Colour. Scape yellowish-white, pedicel and flagellomeres dark brown. Head and mesosoma golden-green, gaster dark brown with golden-green tinges. Fore coxa yellowish white with base infuscate, mid coxa yellowish-brown with base infuscate, hind coxa dark brown with metallic tinges; tibiae pale yellowish-brown with bases more or less infuscate; tibiae pale yellowish-brown; tarsi with tarsomeres 1–3 yellowish-brown and tarsomere 4 pale brown. Wings hyaline.

Head. Scape 2.0× as long as wide; ratios length/width of flagellomeres I/II/III/IV/V/VI: 1.5/1.3/1.2/1.0/0.8/0.7. Frons and vertex with very weak and superficial reticulation; occipital margin rounded without carina. Ratios width/height/length of head 1.9/1.0/1.5; height of eye/malar space/mouth opening 1.5/1.0/1.3; distances between posterior ocelli (POL)/between ocelli and eyes (OOL) 1.8/1.0.

Mesosoma. Mesosoma 1.5× as long as wide. Pronotum medially 1.2× as long as midlobe of mesoscutum. Mesoscutum 0.7× as long as scutellum, with very weak and fine reticulation and short setae scattered over surface; midlobe with two long setae close to posterior margin; notauli complete and deep. Scutellum 0.9× as long as wide, with very weak and fine reticulation and two pair of setae attached close to lateral margin, the anterior pair about in the middle and posterior pair ⅔ from anterior margin of scutellum. Fore wing 2.6× as long as wide; submarginal vein with three setae on dorsal surface; speculum small and closed below; basal cell covered with setae; costal cell narrow, 14× as long as wide, with a complete row of 9 setae on ventral surface; ratios of length of marginal/postmarginal/stigmal veins 5.3/3.3/1.0. Propodeum steeply sloping; median part with 6+6 short setae on either side of an imaginary median line and setae pointing towards the imaginary median line; propodeal callus with eight setae.

Metasoma. Petiole very short and inconspicuous. Gaster ovate, 1.7× as long as wide. Ratio length of mesosoma/length of gaster 0.8.

Variation. Minimal in the paratype material, the length varies from 0.9–1.1 mm; in one Swedish specimen the mid coxa is dark brown, and the median part of the propodeum has 5+5 setae in another Swedish specimen and 8+8 setae in one French specimen.

Female. Unknown.

Host. Unknown, but based on records for other species in *Foersterella* it probably is an egg parasitoid of some species of *Cassida* (Coleoptera: Chrysomelidae).

Distribution. France, Sweden.

Etymology. Named after the completely dark antennal flagellum in the male.

Foersterella reptans (Nees)

Figs 3, 8, 11, 12, 14

Pteromalus reptans Nees, 1834: 114. Type material not located.

Tetracampe flavipes Förster, 1841: 34. Type material in NHMW, not examined. Synonymized by Bouček (1992: 32).

Tetracampe galericcae Thomson, 1878: 183. Synonymized by Bouček (1958: 69).

Hyperbius flavipes (Förster), Förster (1878: 58).

Foersterella flavipes (Förster), Dalla Torre (1898: 87).

Tetracampe reptans (Nees), Bouček & Rasplus (1991:134).

Foersterella reptans (Nees), Bouček (1992: 32).

Material (25♂). Czech Republic (5♂ BMNH, MZLU); England (5♂ BMNH); France (4♂ BMNH); Sweden (11♂ BMNH, MZLU).

Diagnosis. *Male.* Antenna (Figs 3, 8): F1 and 2 each 1.4×, F3 1.2×, and F6 0.7× as long as wide; antennal clava (in widest part) 2.0× as wide as greatest width of pedicel; F1–3 and clava dark brown, F4–6 yellowish-white; face with rather dense setation, as in *F. erdoesi* (Fig. 6).

Hosts. Endoparasitoid in eggs of *Cassida deflorata* Suffrian (Labeyrie 1961), *C. murraea* L. (Bouček & Askew 1968), *C. rubiginosa* (Bouček 1958), and *C. viridis* L. (Bouček 1958) (Coleoptera: Chrysomelidae). I have not seen any reared specimens of this species, and in view of the confusion with species identification, host records in literature must be regarded with caution.

Distribution. Austria, Czechoslovakia, Denmark, Germany, Hungary, Sweden, Yugoslavia (all seven records in Bouček 1958), France (Labeyrie 1961), Italy (Herting 1973), Romania (Herting 1973), United Kingdom (Graham, 1963). In view of the confusion with species identification, distribution records in literature must be regarded with caution.



FIGURE 14. *Foersterella* sp., female, habitus in lateral view, specimen length 1.2mm. Specimen from England, Middlesex, collected and mounted by M.W.R. de V. Graham (specimen in BMNH).

Acknowledgements

I am especially indebted to Alex Gumovsky (Schmalhausen Institute of Zoology, Kiev, Ukraine) for important information regarding *Foersterella seyhanensis* Doganlar from Turkey, and for comments on the manuscript. Thanks also to the Swedish Taxonomy Initiative for funding (dha 2013-139), and to Natalie Dale-Skey (BMNH) for loan of specimens.

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